Spin physics with STAR at RHIC

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Our group continues to play major roles in STAR investigations of both longitudinal and transverse spin phenomena in polarized *pp* collisions at RHIC. A major goal of the RHIC spin program is to determine the gluon polarization in the proton over a wide range of momentum fraction x. The longitudinal double-spin asymmetry, A_{LL}, for inclusive jet production is an ideal tool in this effort because the cross section is large and dominated by quark-gluon and gluon-gluon scattering processes, both of which have large partonic asymmetries.

For the past several years, we have been working on the analysis of A_{LL} for inclusive jets at $\sqrt{s}$ = 510 GeV, based on data that STAR recorded during 2012. In last year's *Progress in Research*, we described the improvements that we had developed in jet reconstruction, notably including an underlying event subtraction procedure. We also described the development of a new PYTHIA tune that provides a much better reproduction of jet data at RHIC energies.

During the past year, we performed the companion Monte Carlo analyses that were needed to estimate the corrections for the jet energy scale distortions and trigger and reconstruction bias, together with the corresponding systematic uncertainties. We found that the underlying event subtraction provided a much better match between jets observed in the detector and the parent hard-scattered parton jets of interest to determine the gluon polarization. We also developed new procedures to estimate the trigger and reconstruction bias and the PYTHIA tune uncertainties. In both cases, the new procedures led to substantially smaller systematic uncertainties than we would have obtained if we had used our previous procedures.

We have now completed the analysis of the 2012 data. Overall, our new analysis procedures reduce the systematic uncertainties by factors of 2~3 compared to those with our previous methodology. The new results are in very good agreement with the predictions from DSSV'14 [1] and NNPDFpol1.1 [2]. They also extend the range of x_T (= 2 $p_T/\sqrt{s}$) down to 0.026, compared to x_T = 0.056 for the 2009 measurements at 200 GeV [3]. We have not performed a full reweighting of either DSSV'14 or NNPDFpol1.1 to assess the impact of the new 2012 results. However, extrapolating from a reweighting of NNPDFpol1.1 to factor in other recent data [4], we expect the new results will provide a sizable reduction in the uncertainty in the gluon polarization uncertainty in the region $0.02 < x < 0.1$.

At present, we are writing the final article describing the 2012 inclusive jet analysis and results. We are combining the 2012 inclusive jet analysis that we've performed at Texas A&M together with the companion di-jet A_{LL} analysis of the same data set that is currently being finalized by collaborators at the University of Kentucky. We hope to submit the article for publication before the end of this year.

[1] D. DeFlorian *et al*., Phys. Rev. Lett. **113**, 012001 (2014).
[2] E.R. Nocera *et al*. (NNPDF Collaboration), Nucl. Phys. B **887**, 276 (2014).
[3] STAR Collaboration, Phys. Rev. Lett. **115**, 092002 (2015).
[4] E.R. Nocera, arXiv:1702.05077